Land Cover and Land Use Change and the Kyoto Protocol

- **The Protocol**
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  - **implementation**
- **The Carbon Cycle**
  - **global**
  - **regional**
- **Carbon sources and sinks**
- **Future Needs**

THE PROTOCOL

The Commitment

Annex 1 countries (industrial nations and nations with economies in transition) have agreed to reduce greenhouse gas emissions to about **5% of 1990** emissions by the Commitment Period (2008-2012)

THE PROTOCOL

Implementation

Increasing carbon sinks through **land-use change** is considered equivalent to reducing emissions (sources) of carbon though only three types of land-use change are presently recognized by the protocol:

Afforestation (planting new forests where none previously existed)
Reforestation (growing forests where they did exist previously)
Deforestation (converting forests to other landscapes)

Other 'activities' may be added to these ARD activities, such as:
Degradation of forest biomass – through harvests, shifting cultivation
Changes in soil carbon as a result of agricultural management
Changes resulting from fire management
All changes in carbon, whether attributable to activities or not

CARBON CYCLE

Global Scale (PgC/yr averaged for the 1980s)

Atmospheric C increase	=	fossil fuel	+	land-use change	-	oceanic uptake	-	terrestrial uptake (not due to landuse change)

$$3.3(\pm 0.2) = 5.5\ (\pm 0.5) + 2.0(\pm 0.8) - 2.0(\pm 0.8) - 2.2\ (\pm 1.3)$$

Regional Scale

~75% of fossil fuel emissions are from temperate –zone and boreal countries (Annex 1 countries)

~100% of the net flux of carbon from land-use change is from tropical countries (non-Annex 1 countries)

CARBON SOURCES and SINKS

- **Example Types:**
  - **Sources - Industrial activity** (dominant source of CO_2)**, clearcutting, fire**
  - **Sinks – forest regrowth/plantations**

    About half of the 2.2 PgC/yr terrestrial sink unrelated to land-use change has been 'observed'.
  - **Management**

    Long-term growth on permanent sample plots suggests an uptake of 0.6 PgC/yr in unmanaged tropical American forests.
- **Pools lifetime**
  Forest growth observed in forest inventories exceeds growth expected from land-use change by 0.6 PgC/yr in northern temperate-zone and boreal regions.
- **Measurement**
  Attributing cause to observed changes is difficult; for example partitioning the cause of observed forest growth among management, CO2 fertilization, climatic variability, N deposition, or attributing loss of forests observed with remotely sensed data to "deforestation", as opposed to natural fire requires integrated measurement protocols.

FUTURE NEEDS

•Need to generate national estimates of forest gain / loss and degradation since 1990 baseline (some national statistics already exist, compilation of existing information is necessary)

•Remote sensing could provide a system to provide all countries high level products for determining changes of forest area (maps for 1990, 2008 and 2012) - high resolution systems e.g. Landsat

•Need to address role of remote sensing data for primary data or for verification of national claims of sources and sinks or both 20m data and 1m verification

•Development of new technologies to measure above ground biomass directly

•Establishment of infrastructure for data collection by non Annex 1 nations